

ANDRÉ-MARIE AMPÈRE AND HIS ENGLISH ACQUAINTANCES

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INTRODUCTION

THE early years of the nineteenth century were a time of new life and fresh thought in the scientific institutions of England and France. Despite the domination of the public scene by the rise and fall of Napoleon, scientists in the two countries were able to share their discoveries and work together. Napoleon even encouraged this; for example, foreigners were not barred from competing for the scientific prizes he offered. At a time when many of his compatriots were detained in France, Sir Humphry Davy was given special permission to travel freely because the object of his journey was scientific. His travels in France gave Davy the opportunity of meeting many of his most eminent contemporaries. The best scientific work in Europe was being done in Paris at the Collège de France and at the Ecole Polytechnique. H. R. Yorke, an English journalist in Paris in 1814, in spite of his prejudice against the Institut National affirms that 'it is but a tribute of justice which every man owes to superiour genius to declare that in point of real science or experimental philosophy FRANCE IS WITHOUT A RIVAL'.¹

It was in 1814 that Ampère was elected to membership of the Institut. He was then 38 years old. He had not reached this position without a struggle. Although he received no formal education he had mastered the *Mécanique Analytique* of Lagrange by the time he was 18. He gave private lessons with considerable success in Lyon, his birthplace, and was then appointed to teaching posts, first at Bourg and then at Lyon; after the death of his wife in 1803, he moved to Paris and obtained a post at the Ecole Polytechnique. At this stage his reputation rested entirely on his ability in mathematics, but this was only one of his many interests. His correspondence reveals the depth of his knowledge of metaphysics, chemistry, botany and physics. Like Davy he was something of a poet and a man of letters.

DAVY AND THE HALOGENS

Ampère was in no way embittered by the political struggle between England and France; he was, in fact, one of the first to welcome new ideas from across the channel. The whole of his life was characterized by his readiness to accept new scientific developments and his generosity in

¹ H. R. Yorke: *Letters from France* (London, 1814), ii, 336.

acclaiming their authors. Dr. Paris in his life of Davy² records that when Davy's first visit to France was anticipated, Ampère was one of the loudest in his praises, and 'had for several years frequently expressed his opinion that Davy was the greatest chemist that had ever appeared'. This admiration is apparent in Ampère's first letter to Davy,³ dated 1 November 1810, which ends thus:

'... permettez que je m'applaudisse d'avoir trouvé cette heureuse occasion de vous offrir l'hommage de mon profond respect et de l'admiration aussi vive que sincère que m'ont inspirée vos immortelles découvertes'.

This was the beginning of a correspondence which lasted until at least 1825. The first purpose of Ampère's letter was to congratulate Davy on his discovery of potassium and sodium and to associate himself with Davy's view in opposition to Thenard and others. The major part of the letter, however, was concerned with Davy's views on chlorine. With these Ampère was in complete agreement; indeed, according to an autobiographical note of 1824, he had already reached these conclusions independently but had not published his findings. This fact seems to have been appreciated by his contemporaries, for Gay-Lussac and Bidault de Villiers both refer to it in articles in the *Annales de Chimie*.⁴

In this same letter Ampère suggested an analogy between chlorine and fluorine which Davy later admitted to be correct. 'Your ingenious views respecting fluorine may be confirmed,' he writes in a later letter,⁵ and in a paper read to the Royal Society on 8 July 1813⁶ he acknowledged his debt to Ampère:

'M. Ampère communicated his views to me in the most liberal manner: they were formed in consequence of my ideas on chlorine.'

He omitted to point out, however, that he had opposed Ampère's views on the subject for two years.

In the course of the correspondence with Davy about fluorine Ampère mentioned the discovery by Dulong of a 'detonating oil' (nitrogen tri-chloride) which had cost the latter an eye and a finger.⁷ Davy instantly set to work on this explosive and was himself involved in two accidents. In the letter quoted above he enclosed a paper on the fulminating oil and recounted his accident. He apologized for not using Ampère's name in the paper as he had not thought it right to do so without permission. To this Ampère replied on 20 June 1813 asking Davy to use his name whenever possible,⁸ an obligation which Davy discharged in his

² J. A. Paris, *Life of Sir Humphry Davy* (London, 1831), ii, 10.

³ L. de Launay, *Correspondance du Grand Ampère* (3 vols, Paris, 1936 and 1943. Published by the Société des Amis d'André-Marie Ampère), 355.

⁴ *Annales de Chimie*, xci, 98; xciii, 41.

⁵ *Correspondance*, 430.

⁶ *Philosophical Transactions of the Royal Society*, 1813, 265.

⁷ *Correspondance*, 414.

⁸ *Ibid.*, 444.

second paper on the subject read to the Royal Society in July 1813. Ampère's eagerness to share Dulong's discovery with the English scientist had led to an infringement of scientific protocol, as the discovery was published in England before it was generally known in France. This caused Ampère considerable embarrassment.

A similar situation now began to develop in connection with iodine. This substance had been discovered in 1811 by Courtois who, through pressure of work, was unable to complete his investigations. He asked Clément to undertake the task, but 18 months elapsed before the new substance was made public. During this time the only people outside Clément's laboratory who had seen it were Ampère and Chaptal. In his letter of 20 June, Ampère mentioned this discovery to Davy and expressed the view that it would prove to be analogous to chlorine and fluorine:

'Aujourd'hui toutes les substances simples semblent se partager en deux grandes classes: les corps comburants et les corps combustibles. L'existence de deux comburants, l'oxygène et le chlore, est actuellement mise hors de doute. Le fluorine va s'y joindre, et peut-être en trouvera-t-on bientôt un quatrième dans une substance nouvelle, récemment découverte en France et dont j'ai vu des effets extrêmement singuliers, mais sur laquelle je ne puis encore vous donner aucun détail.'⁸

Thus Ampère was the first to suggest that iodine was an element and this priority he claimed in a letter to his friend Roux-Bordier in the following year.

'Vous savez toutes les belles choses qu'on a faites sur l'iode qui s'est trouvé un quatrième oxygène comme je l'avais conjecturé le premier. Cette substance a toutes les propriétés du chlore, . . .'⁹

Later in 1813 Davy arrived in Paris and met his correspondent for the first time. As a mark of respect for the English chemist, Clément showed him his work on iodine and on 23 November Ampère presented him with a specimen. Davy at once began to investigate this secret substance and by 11 December he had prepared two papers on the subject, one for the Royal Society and one for the Institut National.¹⁰ Gay-Lussac first learned of the substance which he later named iodine when it was announced to the Institut on 29 November. At his friend Clément's invitation he took over the research and his findings were read to the Institut on 6 and 20 December.¹¹ His conclusions were similar to Davy's and it is generally agreed that they share the honours for elucidating the nature of iodine. Nevertheless, Paris records that Thenard and Gay-Lussac 'still retained great bitterness of feeling towards Davy on account of the affair of iodine', 17 years later.¹²

⁸ *Ibid.*, 462.

¹⁰ *Phil. Trans. Roy. Soc.*, 1814, 74; *Annales de Chimie*, lxxxviii, 322.

¹¹ *Annales de Chimie*, lxxxviii, 311 and 319.

¹² Paris, *op. cit.*, ii, 23.

Much of the information about the relations between Ampère and Davy at this time is derived by Paris from Thomas Underwood, a *détenu* in France throughout the Napoleonic Wars, who introduced the two scientists to each other. Later he was a frequent bearer of letters between England and France. This interesting man, a watercolourist of some repute, had a wide and influential circle of friends which included scientists, politicians and writers of the times. It was he who introduced Davy to Rumford and secured his position at the Royal Institution. All his life he kept a journal and the discovery of this manuscript would be of great interest to any historian of the period.¹³

ELECTRODYNAMICS

The greater part of Ampère's correspondence with his English friends dates from 1820 and concerns the work in electricity and magnetism for which he is best known. Oersted made his discovery of the magnetic effect of an electric current in the spring of 1820 and news of it appears to have reached Geneva by the summer of 1820. Here Arago witnessed the repetition of Oersted's experiment and on his return to Paris at the beginning of September he announced the discovery to the French Royal Academy of Sciences. According to his brother, Davy also learned the news from a friend in Geneva and in a letter dated 19 October he referred to 'some vague experiments of Oersted'.¹⁴ Both Ampère and Davy began to experiment, but this time Ampère far outstripped his English friend. His imagination was fired by the discovery and for a time he could think of nothing else:

'Depuis que j'ai entendu parler pour la première fois de la belle découverte de M. Oersted . . . j'y ai pensé continuellement, je n'ai fait qu'écrire une grande théorie sur ces phénomènes et tenter des expériences indiquées par cette théorie.'¹⁵

The fruit of his thoughts and his experiments is to be found in a succession of papers read to the Academy almost weekly for the next three months. The speed with which these papers were produced is not at all characteristic of Ampère, who preferred to revise his work constantly before presenting it to the public. He was no less prompt to announce his discoveries abroad. In a letter dated 11 October 1820, which only exists in contemporary translation, he sent copies of his work to Wollaston, then acting President of the Royal Society.¹⁶ He also referred to copies of further papers still in the press which he intended to send to the Royal Society

¹³ One year of this diary was published by John Britton under the title *Narrative of Memorable Events in Paris* (London, 1828).

¹⁴ J. Davy, *Memoirs of the Life of Sir Humphry Davy* (London, 1836), ii, 142.

¹⁵ *Correspondance*, 562.

¹⁶ Manuscript letter: Ampère to Wollaston, 11 October 1820. Royal Society reference AP. 9.2.

later. These papers were received by Davy, who by then had succeeded to the presidency.

Davy had read a paper on electro-magnetism to the Royal Society in November 1820, but on receiving Ampère's letter he realized that his own work was relatively unimportant. For the first time in the correspondence there is a note of humility in his reply to Ampère on 10 February 1821.

'Before I knew that you were pursuing M. Oersted's experiment, I had myself entered into some researches on the subject and I communicated to the Royal Society a short paper containing an account of them; they are published; but I find that they have lost the merit of novelty for most of my observations have occurred to other philosophers.'¹⁷

From the rest of the letter it is clear that Davy was reluctant to accept Ampère's theory identifying electricity and magnetism.

Faraday, who had also met Ampère in Paris seven years earlier, was more willing to entertain his notions and discussed them in detail in his first paper on electromagnetic rotation which appeared in the *Quarterly Journal* in the autumn of 1821. This paper rekindled Ampère's interest in the subject after a lapse due to illness during the greater part of 1821 and it is evident that he wrote to Faraday to congratulate him on his achievements. Faraday's reply appears to be contained in a letter dated 2 February 1821, but which from internal evidence was most probably written in 1822.¹⁸ He ventured 'a few observations on [Ampère's] beautiful experiment of the rotation of the magnet' and described how he had repeated this experiment in which a magnet is made to rotate on its own axis. He went on to describe how he had made a conductor rotate on its own axis. This he appears to have done independently of Ampère, who described a similar experiment in a paper read to the Academy on 7 January 1822.¹⁹ Although the tone of Faraday's letter is diffident, he is ready to express some doubt about Ampère's

¹⁷ *Correspondance*, 563.

¹⁸ *Ibid.*, 909. This letter is dated by Faraday 2 February 1821, but since it refers to experiments on rotation which he did not perform until the autumn of 1821, it seems probable that he misdated the letter 1821 instead of 1822.

Cf. H. Bence Jones, *Life and Letters of Faraday* (London, 1870), i, 339.

¹⁹ J. Joubert, *Collection de Mémoires Relatif à la Physique* (Paris, 1885), ii, 192.

This experiment Faraday must have performed early in 1822, after vol. xii of the *Quarterly Journal* had gone to press. He wrote to Ampère: 'I took a piece of copper wire similar in form to the magnet and having floated it upright in mercury placed a little cup on the top to contain a globule of mercury and then connected the voltaic piles just as they were with the magnet then placing the pole of a strong magnet beneath the cup containing the mercury. It when exactly in line with the axis of the wire made it rotate slowly on its own axis.' This appears to be directly contradicted by Faraday's statement in a letter to Richard Phillips, dated 10 May 1836, in which he says: '*I did not realize* the rotations of the electromagnetic wire round its axis; that fact was discovered by M. Ampère at a later date . . .' (Faraday, *Experimental Researches*, ii, 231). From this it is clear that his denial refers only to the October experiments which appeared in the *Quarterly Journal*, vol. xii, 74 ff. The only explanation of this discrepancy appears to be that Faraday did not consider it worth publishing this experiment once he found that Ampère had already made the discovery and announced it publicly.

theories. De la Rive, a common friend of the two scientists, reproached Faraday with 'not sufficiently esteeming Ampère's experiments'. To this charge Faraday replied,

'M. Ampère's experiments are excellent and his theory ingenious; . . . being naturally sceptical on philosophical theories I thought there was a great want of experimental evidence. Since then, however, I have engaged on the subject and have a paper in our Institution journal . . . which will, as it contains experiment, be immediately applied by M. Ampère in support of his theory much more decidedly than it is by myself.'²⁰

Ampère's letter to his friend Bredin proves just how right this prediction was:

'Depuis que le mémoire de M. Faraday a paru je ne rêve plus que courants électriques. Ce mémoire contient des faits électromagnétiques très singuliers qui confirment parfaitement ma théorie quoique l'auteur cherche à la combattre pour lui en substituer une de son invention.'²¹

It was not merely scepticism about philosophical theories which presented Faraday with difficulty in accepting Ampère's ideas; as he freely admits in his letter to Ampère, it was his deficiency in mathematical knowledge which made him 'dull in comprehending these subjects'. It was, of course, Ampère's knowledge of mathematics which enabled him to carry his researches far beyond the work of his contemporaries and to lay the foundation of the science of electrodynamics.

Ampère's life at this time was an unremitting struggle against poor health and pressure of work at the Ecole Polytechnique and in the University, and it was July before he had time to answer some of the difficulties which Faraday had raised concerning his theory of molecular currents. In addition he demonstrated the superiority of his theory to Wollaston's theory of 'electromagnetic currents'. Faraday was still cautious; for one thing he was somewhat awed by the opinions of such giants as Berzelius and Prechtel, who opposed Ampère,²² and again he was diffident about his 'want of mathematical knowledge . . . and power of abstract reasoning'. But the real trouble lay deeper; at this stage in his development Faraday was unhappy with a theory in terms of unobservable entities with which he could not experiment directly.²³

Ampère, in his reply of 18 April 1823,²⁴ adduced fresh instances where his theory accounted for the observed facts. He submitted Faraday's latest experiment concerning the rotation of a magnet floating in mercury to analysis in terms of his own theory and triumphantly pointed out that

²⁰ Bence Jones, *op. cit.*, i, 355.

²¹ *Correspondance*, 576.

²² Cf. the analysis of Ampère's early notions in R. A. R. Tricker, 'Early Electrodynamics', and also in L. Pearce Williams, 'Ampère's Electrodynamical Molecular Model', in *Contemporary Physics*, iv, 119.

²³ *Correspondance*, 928.

²⁴ *Ibid.*, 630.

his forecast conclusion agreed precisely with the results of the experiment. He confidently expected that Faraday would one day make further discoveries which would lead to the general acceptance of his theory.²⁵ It should be noted that although much has been made of this difference of opinion, there was nothing acrimonious in this discussion; Faraday, the younger by 16 years, was deferential, and Ampère was unfailingly patient and courteous. Two years later he made a fresh attempt to persuade Faraday of the truth of his theory when he realized that the Amperian currents did not need to be circular but could take the shape of any closed plane curve. By the same bearer, Mr. South, he also sent a letter to John Herschel emphasizing the same point.²⁶

As Faraday's position in the scientific world became more assured, it was to him that Ampère directed his enquiries about the progress of his own ideas in England. In 1824 and again in 1825 he asked whether the apparatus he had designed and made in Paris had been reproduced in London. Ampère's diagrams for this apparatus had appeared in the *Quarterly Journal* and also in the *Edinburgh Philosophical Journal*, since Brewster, the secretary of the Royal Society of Edinburgh, also corresponded with Ampère.²⁷ His principal concern here was that the mutual action of two currents should be demonstrated by experiment, since he believed that people would thus be convinced that this fact was basic to a proper understanding of electrodynamics.

This phase of the correspondence between Ampère and Faraday comes to an end about the time of the conclusion of Ampère's final great memoir on electrodynamics in which he summarized all his work since the memorable autumn of 1820. Faraday's major work was still to come.

ELECTROMAGNETIC INDUCTION

Faraday made his discoveries of electromagnetic induction in the second half of 1831, but the ground had been prepared and it is important to see what contributions had already been made. As early as 1822 during a brief visit to Geneva, Ampère, with the help of Auguste de la Rive, devised an experiment which had as its object (in his own words) 'de savoir si l'on peut produire un courant électrique par l'influence d'un autre courant'. With the help of a big magnet made available by Professor Pictet, Ampère succeeded, where he had failed a year earlier, in detecting induced currents when a closed copper coil was attracted and repelled by the magnet. On his return to Paris he gave an account of this experiment to the Academy of Sciences.²⁸

²⁵ Cf. *History of Science*, i (Cambridge, 1962), 6, where L. Pearce Williams draws attention to the fact that Faraday never did accept Ampère's theory.

²⁶ Manuscript letter: Ampère to Herschel, 25 October 1825. Royal Society reference HS. 1.394.

²⁷ *Correspondance*, 922.

²⁸ Joubert, *op. cit.*, ii, 332.

In 1824 Arago discovered the electromagnetic damping of an oscillating magnet in the presence of a sheet of conducting material. A year later he devised the famous experiment known as Arago's Disc which excited considerable interest on both sides of the channel. In England Herschel and Babbage presented two papers to the Royal Society on this subject, though no satisfactory explanation of the various phenomena was given until Faraday announced his discoveries in 1831. It is interesting to note that both Herschel and Babbage communicated their discoveries to Ampère personally. On receipt of the paper read by the two scientists to the Royal Society in June 1825²⁹ Ampère wrote on 25 October to thank them and linked their experiments with his own of 1822:

'La manière dont ces phénomènes sont produits par l'action du courant ou de l'aimant sur les petits courants électriques développés . . . par l'influence de l'aimant conformément à une expérience que je fis à Genève en 1822 et qui a été publiée dans le tems par M. Auguste de la Rive est un sujet sur lequel je regrette toujours de n'avoir pas eu le tems d'écrire.'³⁰

In the Babbage collection in the British Museum there is another letter from Ampère acknowledging the receipt of Babbage's paper read to the Royal Society in 1826.³¹

During the summer of this year Ampère worked with Arago on the disc experiment, and during Arago's absence in August he succeeded in repeating it, using a suspended solenoid instead of a magnet. Ampère was careful to credit Arago with the idea of the experiment, although he saw in it a further demonstration of his own theory. Herschel, who was in Paris with Wollaston at the time, witnessed the experiment and was so impressed that he persuaded Wollaston to see it too. Ampère recounted this incident in a letter to his son:

'Je parlai à M. Wollaston pour qu'il vît mes expériences. Cela ne prenait pas d'abord; ce qui m'ennuyait beaucoup. Mais M. Herschel qui est aussi à Paris et qui les a vues, étant survenu, en parla à M. Wollaston de manière à lui inspirer le désir de les voir. Et il fut convenu que je les lui ferais demain à midi. Sans cette rencontre chez M. Cuvier, j'aurais manqué cette occasion de les montrer à un de ceux auxquels il m'est le plus important de les faire voir.'³²

Wollaston's presence in the laboratory was so important because recognition at home and more particularly abroad of new discoveries was one of the thorniest problems the scientist had to face. It was this same problem which caused the only real cloud to pass over the correspondence between Ampère and Faraday.

²⁹ *Phil. Trans. Roy. Soc.*, 1825, 467.

³⁰ As note 26.

³¹ *Phil. Trans. Roy. Soc.*, 1826, 494.

Manuscript letter: Ampère to Babbage, 17 November 1825. British Museum reference 37183, f.303.

³² *Correspondance*, 688.

News of Faraday's discovery first reached Paris in a letter to Hachette in 1831, but it was more than a year later that Ampère first read the memoir on electromagnetic induction in the *Philosophical Transactions* for 1832. He was distressed to find that a note in Faraday's memoir referred to an unsuccessful experiment by Ampère in this field. This attempt had been made in Paris at the suggestion of Fresnel before his Genevan experiment with de la Rive in 1822. Ampère explained that the purpose of his experiment had been to learn something of molecular currents in ferro-magnetic materials and for this reason he had not investigated the phenomena in more detail. Moreover, Faraday had misunderstood one important aspect of the experiment when he repeated it, using a copper disc instead of a ring as clearly prescribed in the various accounts. He disclaimed any priority in discovering electromagnetic induction, but insisted that his second experiment had been correctly observed and conformed to the principles disclosed by Faraday. Faraday's confusion over Ampère's experiment had injured the latter's reputation and played into the hands of his enemies.³³ Ampère died three years later, but happily one letter survives which shows that Faraday had made *amende honorable* and that the friendship had not suffered.³⁴

DOUBTS AND RECOGNITION

Ampère, who by nature was retiring and sensitive, was always unhappy when his work encountered opposition. The Institut was riddled with petty jealousies which a man of Ampère's temperament was ill-equipped to face. Biot's spiteful insinuations that he had capitalized on Oersted's discovery were the first stage in a campaign to belittle his achievements. He complained to Faraday of the activities of his enemies, who cast doubts on his experiments and sought to harm his reputation abroad. At this time (1825) Faraday had every reason to sympathize, as the rift between Davy and himself had just become apparent. In a letter (now in the Burndy Library) he wrote in November,

'I am sorry to find by one of your letters that you experience an unworthy opposition to the fair and high claim you have to the approbation and thanks of your fellow Philosophers. This, however, you can hardly wonder at. I do not know what it is nor by whom exerted in your case, but I never yet even in my short time knew a man to do anything eminent or become worthy of distinction without becoming at the same time, obnoxious to the cavils and rude encounters of envious men. Little as I have done, I have experienced it and that too where I least expected it.'³⁵

He declares that Ampère's fears for his reputation in this country were exaggerated. Nevertheless, it is undeniable that many of the scientific

³³ *Ibid.*, 763.

³⁴ *Ibid.*, 788.

³⁵ Manuscript letter: Faraday to Ampère, 17 November 1825, in the Burndy Library, Connecticut, U.S.A.

periodicals had a patriotic bias, witness this passage in the *Quarterly Journal*:

'Although we have great respect for Messrs Arago and Ampère we think they have indulged in electromagnetic speculations bordering on absurdity. Our information on this very curious subject is extremely limited, and we do not hesitate to ascribe to the researches of Oersted, Davy, Wollaston, Faraday and Seebeck all that has really and actually been acquired in respect of it.'³⁶

It is only fair to note that the French *Bulletin* equally attacks the English scientists, saying of Herschel, for example:

'Herschel . . . a, aux yeux des physiiciens italiens, répété comme de son invention des expériences qu'il s'attribuait illégitimement.'

The writer further castigates the English for their neglect of Ampère.

'Tel était l'éloignement que les savans anglais manifestaient pour la théorie de M. Ampère que pendant longtems ils n'ont pu se mettre en état de répéter quelques-unes des expériences que ce géomètre avait imaginées pour vérifier les conséquents de sa théorie. Ses mémoires étaient parfois traduits dans les journaux de Londres mais ils n'y produisaient aucun effet.'³⁷

Both Faraday and Ampère were at pains to dissociate themselves from these attacks. Faraday declared,

' . . . whenever opportunity occurs, I do full justice to your important investigations for as far as I can go with them I am convinced of their accuracy and great Value.'³⁸

Ampère on his side even waged war with the director of the *Bulletin* on Herschel's behalf. He wrote,

'Nul n'a été plus choqué que moi qu'il eût trouvé place dans le Bulletin de M. de Férussac. Lorsque j'en ai fait des reproches à ce dernier il m'a écrit une lettre où il désavoue cet article et déclare que s'il avait eu connaissance il n'aurait jamais laissé imprimer un tel article qu'on devait uniquement attribuer à M. Saigey. J'étais d'autant plus choqué de ce misérable article que l'auteur avait joint à la fin des louanges de mes travaux sur la physique par lesquelles il semblait m'associer à ces sottises.'³⁹

Despite all efforts to undermine his reputation, Ampère acquired an increasing number of good friends in the learned societies. The principal ones have already figured in this article as his correspondents, but a close reading of his letters reveals his acquaintance with such men as South, Herschel's colleague, Francis Lunn, and Alexander d'Arblay, the son of Fanny Burney. He was first honoured in this country by the Royal Society of Edinburgh, which elected him to Foreign Membership

³⁶ *Quarterly Journal of Science and Arts*, xvi, 342.

³⁷ *Bulletin Universel*, 1827.

³⁸ As note 35.

³⁹ Manuscript letter: Ampère to Herschel 16 September, 1827. Royal Society reference HS. 1.395.

in 1822. A year later he was invited to become an Honorary Fellow of the Philosophical Society of Cambridge, which has preserved Ampère's reply to the invitation in its archives. But the honour he esteemed most highly was undoubtedly Foreign Membership of the Royal Society of London which came to him in 1827. It has been alleged by Paris that Davy opposed his election, but the certificate of nomination, signed by Davy, and his brother's spirited denial of the accusation make it hard to believe that this was so. Herschel was one of the 11 supporters of the nomination and there can be no doubting the sincerity with which Ampère writes to this friend of

'un événement de ma vie que je regarde comme un des plus heureux et des plus glorieux pour moi—je veux parler du choix que la société royale de (Londres) a daigné faire de moi comme un de ses membres étrangers'.⁴⁰

CONCLUSION

This struggle for the recognition of his work in England is the key to the relationship between Ampère and his English friends. The correspondence cannot be said to have achieved any real degree of intimacy, as did his letters to de la Rive, for example. His difficulty in understanding English was a serious handicap as can be seen in a letter to Gay-Lussac in the Cambridge University Library; and it is perhaps unfortunate that he never took the opportunity of coming to England to expound his discoveries in person.⁴¹ Since his death the prime importance of his law of the mutual action of two currents has never been challenged, but as it is easier to teach the subject of electrodynamics by introducing the concept of the magnetic field, the simpler Biot-Savart formula has always been preferred to his.⁴² Perhaps this policy stems, paradoxically, from one of his greatest English admirers, James Clerk Maxwell, who chose this method of exposition in his *Treatise on Electricity and Magnetism*, but in the same work wrote of Ampère and his achievement: 'The experimental investigation by which Ampère established the laws of the mechanical action between electric currents is one of the most brilliant achievements in science. The whole, theory and experiment, seems as if it had leaped, full grown and full armed, from the brain of the "Newton of Electricity"'.⁴³

⁴⁰ As note 39.

⁴¹ Manuscript letter: Ampère to Gay-Lussac, 19 August 1828. Cambridge University Library reference 4251(21). This is a letter of recommendation for an Englishman, Barry, who wanted to use some apparatus in Paris. As Ampère did not understand English well, he did not know the exact nature of Barry's request.

⁴² Dr. Tricker presents a strong case for the inclusion of Ampère's work in the teaching of electrodynamics. See R. A. R. Tricker, 'On the Teaching of Electricity—III' in the *School Science Review*, xxxvi (1955), 213, and also by the same author 'Ampère as a Contemporary Physicist' in *Contemporary Physics*, iii (1962), 453.

⁴³ J. C. Maxwell, *Treatise on Electricity and Magnetism* (Oxford, 1873), 162.